

**CLAIMS**

- 1 1. A fuel for use in a fuel cell, comprising:
  - 2 (A) a carbonaceous fuel substance ; and
  - 3 (B) a thickening substance that imparts viscosity to the fuel substance,
- 4 thereby forming a gel fuel.
- 1 2. The fuel as defined in claim 1, wherein said carbonaceous fuel substance is
- 2 substantially comprised of neat methanol.
- 1 3. The fuel as defined in claim 1, wherein said neat methanol comprises between
- 2 about 90 to 100 per cent by weight of the total composition of the fuel substance.
- 1 4. The fuel as defined in claim 1, wherein said thickening substance is substantially
- 2 comprised of Carbopol® EZ-3.
- 1 5. The fuel as defined in claim 1, wherein said thickening substance comprises about
- 2 2 per cent by weight of the total composition of the fuel substance.
- 1 6. The fuel as defined in claim 1, wherein said alkaline pH-modifying substance is in
- 2 an amount sufficient to adjust the pH to a value of about 4.0.
- 1 7. The fuel as defined in claim 1, wherein said alkaline pH-modifying substance is
- 2 substantially comprised of sodium hydroxide.
- 1 8. The fuel as defined in claim 1, wherein said alkaline pH-modifying substance
- 2 comprises about 0.04 per cent by weight of the total composition of the fuel substance.

1 9. The fuel as defined in claim 1 in which the gel fuel has a viscosity of between  
2 about 1000 to 48,000 mPa s.

1 10. The fuel as defined in claim 1, further comprising safety enhancing additives.

1 11. The fuel as defined in claim 10 wherein said safety-enhancing additives are  
2 selected from the group consisting of colorants, bitters, flame retardants.

1 12. The fuel as defined in claim 1, further comprising polymeric additives.

1 13. A fuel cartridge for use with a fuel cell, the cartridge comprising:  
2 (A) a compartment for holding a fuel suspended in a gel; and  
3 (B) a fuel vapor permeable layer “FVPL” forming one aspect of said  
4 compartment, said FVPL being permeable to a fuel substance that  
5 is released out of said gel, and said aspect of said compartment  
6 being coupled with said fuel cell in such a manner that the fuel  
7 travels through said FVPL into said fuel cell.

1 14. The fuel cartridge as defined in claim 13 wherein said FVPL is substantially  
2 comprised of a highly selective material having selectivity between fuel substance and  
3 water, such that fuel substance can travel through said monolithic material to said fuel  
4 cell and water is substantially resisted from travelling from said fuel cell into said fuel  
5 cartridge.

1 15. The fuel cartridge as defined in claim 14 further comprising multiple FVPLs, at  
2 least one of which is said highly selective material.

1 16. The fuel cartridge as defined in claim 13 wherein said FVPL is substantially  
2 comprised of a porous material that allows fuel substance to travel into said fuel cell and  
3 water to pass into said cartridge.

1 17. The fuel cartridge as defined in claim 16 further comprising surface area  
2 increasing features having multiple components upon which gel can adhere to provide an  
3 increased surface area of exposed gel.

1 18. The fuel cartridge as defined in claim 13 further comprising a fuel impermeable  
2 removable seal that retains the fuel substance within the cartridge prior to the fuel cell  
3 being used.

1 19. A method of supplying fuel to a fuel cell, the method including the steps of  
2 (A) providing a fuel substance suspending within a gel such that when  
3 contacting air, fuel is evaporated out of said gel; and  
4 (B) directing said evaporated fuel substance into a fuel cell using a  
5 FVPL coupled to a fuel cell which fuel vapor permeable layer  
6 "FVPL" allows fuel substance to pass through it into said fuel cell.

1 20. The method of supplying fuel to a fuel cell as defined in claim 19 including the  
2 further steps of:

3 (A) providing neat methanol;  
4 (B) mixing a thickening substance into said neat methanol;  
5 (C) adding a pH-balancing substance to said neat methanol mixture to  
6 form a gel fuel;  
7 (D) placing said gel-fuel in a cartridge that has at least one methanol-  
8 permeable wall; and

(E) attaching said cartridge to a fuel cell with said methanol-permeable wall contiguous to an anode aspect of said fuel cell to thereby supply fuel to said fuel cell.

1 21. The method as defined in claim 20 including the further step of reconstituting the gel  
2 fuel by adding additional liquid fuel.

1 22 A direct oxidation fuel cell system, comprising:

(A) a direct oxidation fuel cell including:

- (i) a membrane electrolyte intimately interfacing with a catalyst layer along each of membrane's major surfaces, being a catalyzed membrane electrolyte, having an anode aspect and a cathode aspect;
- (ii) effective water supply from cathode to anode within said fuel cell, so that water management in said fuel cell is achieved without water collection from the cathode and/or water transport from cathode to anode external to the active volume of the fuel cell;

(B) fuel supply cartridge including:

(i) a compartment for holding a fuel substance suspended in a gel; and

(ii) a fuel vapor permeable layer “FVPL” forming one aspect of said compartment, said FVPL being permeable to the fuel substance that is released out of said gel, and said aspect of said compartment being coupled with said fuel cell in such a manner that the fuel travels through said FVPL into said fuel cell; and

(C) an electrical coupling across said fuel cell for supplying power to an application device.

1 23. A fueling device for a fuel cell system, comprising:

2 (A) an internal fuel compartment that contains a gel fuel coupled to at least  
3 one fuel cell in the fuel cell system for delivering a fuel substance that  
4 evaporates out of said gel fuel; and  
5 (B) a replacement container coupled to said internal fuel compartment for  
6 refueling the gel fuel in said compartment.

1 24. The fueling device as defined in claim 23 wherein said fuel cell system and said  
2 internal fuel compartment are disposed within an application device.

1 25. The fueling device as defined in claim 23 wherein said replacement container houses  
2 a gel fuel for replacing gel fuel in said internal fuel compartment.

1 26. The fueling device as defined in claim 23 wherein said replacement container houses  
2 a liquid fuel for delivery to said internal fuel compartment to reconstitute the gel fuel that  
3 supplies said fuel cell system.